

**CITY OF COLUMBUS
DEPARTMENT OF PUBLIC SERVICE
DIVISION OF DESIGN AND CONSTRUCTION
SUPPLEMENTAL SPECIFICATION 1525
PERMEABLE PAVER PAVEMENT
April 1, 2019**

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1525.00 **Purpose of the Specification:** The purpose of the Supplemental Specification 1525 – Permeable Paver Pavement (SS-1525) for roadways, parking lots, parking stalls, and sidewalks subject to vehicular traffic. SS-1525 provides the designer a standard by which to specify the complete aggregate and paver section in the City of Columbus.

Instructions to Designers:

- A. Follow SS-1525 for all of the following:
 - 1. Permeable Paver Plan Notes
 - 2. Permeable Paver Detailed Drawings
 - 3. Permeable Paver Cross Sections
 - 4. Reference/cite SS-1525 in general summary item descriptions and within all notes and drawings mentioned above as well as any reference to permeable paver design in the project plans and specifications.

- B. Consultant shall confirm with the Capital Improvements Project (CIP) Engineer (Project Manager) for every City of Columbus CIP specifying Permeable Pavement using Pavers for project specific direction or variation (As Per Plan) to SS-1525 as each CIP may have unique circumstances that would dictate a variant design.

Note: Department of Public Service has developed design details with associated notes consistent with SS-1525.

1525.01 **GENERAL**

1525.01.1 **Description of Work:** This specification covers the installation of geotextile fabrics, aggregate base, cellular confinement system, and concrete or clay permeable pavers when used in public roadways, parking lots, parking stalls, and sidewalks.

1525.01.2 **Work in this Section:** This work includes furnishing and installation of subgrade stabilization geotextile, aggregate bases, cellular confinement system, permeable concrete pavers, and impermeable geomembrane liners if necessary. Excavation is paid separately.

1525.02 SUBMITTAL REQUIREMENTS

1525.02.1 Manufacturers' Information: Shall include product information, test results within the last two years, installation instructions and MSDS data for the following:

- A. Subgrade Stabilization Geotextile
- B. Aggregate Sub-base, No. 2 or 4 stone
- C. Aggregate Base, No. 57 stone
- D. Aggregate Setting Bed
- E. Cellular Confinement System
- F. Concrete or Clay Pavers

The contractor shall not start work until manufacturers' information and samples have been approved by the Engineer. Quality control tests as applicable shall be submitted to the Engineer within 5 days of the undertaking the respective test.

1525.02.2 Samples:

- A. At the request of the Engineer, Contractor shall submit for approval up to 20 full size samples of each Paver type/size/thickness/color/finish specified on the plans; the samples shall represent the range of shape, texture and color of the respective type for Engineer selection.
- B. Minimum 40 lb. sample of each aggregate material for independent testing.

1525.02.3 Test Reports for Quality Control: Prior to delivery of the associated material to the site, the Contractor shall submit the following product specific documentation for approval:

- A. Subgrade Stabilization Geotextiles:
 - 1. Certification: The contractor shall provide to the Engineer a certificate stating the name of the manufacturer, product name, style number, and chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. The Certification shall state that the furnished geotextile meets minimum average roll value (MARV) requirements of the specification as evaluated under the Manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the Manufacturer. Certifications from Private Label distributors will not be accepted.
 - 2. Manufacturing Quality Control: Testing shall be performed at an on-site laboratory accredited by GAI-LAP for tests required for the geotextile, at frequency meeting or exceeding ASTM D4354.

3. Manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D4354. A lot size for conformance or quality assurance sampling shall be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

B. Aggregates:

1. Sieve analysis per ASTM C-136 with aggregates clean, washed, and free of fines with <2% passing the No. 200 sieve.
2. Resistance to Degradation of Small-Sized and Large-Sized Coarse Aggregates by Abrasion and Impact in the Los Angeles Machine per ASTM C-131 and ASTM C-535. Aggregates should be crushed with minimum 90% fractured faces and minimum Los Angeles abrasion loss of <40.
3. Percentage of angular and sub-angular particles per ASTM D-2488 greater than 90%.

C. Cellular Confinement System

1. Manufacturer's product data sheets.
2. Manufacturer's Certificate of Analysis: Manufacturer shall supply certificate of analysis containing the following test results for the cellular confinement material used for project: Base Resin Lot Number(s), Resin Density per ASTM 1505, Production Lot Number(s), Material Thickness, Short Term Seam Peel Strength, and percentage of Carbon Black.

Note: For City of Columbus public projects, concrete or clay pavers on the City's Approved Producers and Products list (APPL) are not required to submit quality control test reports.

1525.03 Materials

- 1525.03.1 Subgrade Stabilization Geotextile:** The subgrade stabilization geotextile is placed on the bottom and sides of the excavated trench to prevent aggregate from pushing into the native subgrade causing rutting or other structural failures of the pavement system over time. The geotextile provides soil separation to prevent the migration of soil particles. The geotextile also provides sufficient permeability at an order of magnitude (10x) greater than the native infiltration rate of the soil. This can be achieved with a single woven fabric or a combination of geotextiles and geogrid.

Approved products fall into one of two categories:

1. A single woven geotextile meeting or exceeding the performance of Tencate Mirafi RS-380i.
2. CMSC Item 712.09 Geotextile Fabric Type B overlain with a geogrid per ODOT SS 861 - Supplemental Specification 861 GEOGRID FOR SUBGRADE STABILIZATION

Note: Per SS 861, the minimum opening size of the geogrid must be $\geq D_{50}$ of aggregate above geogrid to provide interlock. The maximum opening size must be $\leq 2 \times D_{85}$ to prevent aggregate from penetrating into the subgrade.

1525.03.2 Aggregate Sub-base, No. 2 or 4 stone:

- A. Clean, non-plastic aggregate, free from deleterious or foreign matter, manufactured from crushed rock.
- B. Percent of angular and sub-angular particles greater than 90%, do not use rounded river gravel.
- C. LA Abrasion loss <40 as per ASTM C-131
- D. CBR >80%
- E. Gradation of subbase aggregate to conform to CMSC Table 703.01-1.

1525.03.3 Aggregate base No. 57 stone:

- A. Clean, washed, non-plastic aggregate, and free from deleterious or foreign matter, manufactured from crushed rock.
- B. Percent of angular and sub-angular particles greater than 90%, do not use rounded river gravel.
- C. LA Abrasion loss <40 as per ASTM C-131
- D. CBR >80%
- E. Gradation of base aggregate course to conform to CMSC Table 703.01-1.

1525.03.4 Aggregate Setting Bed, No. 8 stone:

- A. Clean, non-plastic aggregate, free from deleterious or foreign matter, manufactured from crushed rock.
- B. Percent of angular and sub-angular particles greater than 90%, do not use rounded river gravel.
- C. LA Abrasion loss <40 as per ASTM C-131
- D. CBR >80%
- E. Gradation of setting bed aggregate to conform to CMSC Table 703.01-1.

1525.03.5 Cellular Confinement System

- A. Manufacturing Certification
 - 1. The manufacturer shall have earned a certificate of registration, which demonstrates that its quality-management system for its cellular confinement system (GEOWEB) is currently registered to the ISO 9001:2008 and CE quality standards.
- B. Base Materials
 - 1. Polyethylene Stabilized with Carbon Black
 - 2. Density shall be 58.4 to 60.2 lbs/ft³ (0.935 to 0.965 g/cm³) in accordance with ASTM D 1505.
 - 3. Environmental Stress Crack Resistance (ESCR) shall be 5000 hours in accordance with ASTM D 1693.
 - 4. Ultra-Violet light stabilization with carbon black.
 - 5. Carbon Black content shall be 1.5 to 2 percent by weight, through addition of a carrier with certified carbon black content.
 - 6. Carbon black shall be homogeneously distributed throughout material.
 - 7. The manufacturer must have an in-place quality control to prevent irregularities in strip material.
- C. Cell Properties
 - 1. Individual cells shall be uniform in shape and size when expanded.
 - 2. Individual cell dimensions (nominal) shall be plus or minus 10%.
 - a. Length shall be 8.8 inches (224 mm).
 - b. Width shall be 10.2 inches (259 mm).
 - c. Nominal area shall be 44.8 in² (289 cm²) plus or minus 1%.

3. Nominal cell depth shall be 3 inches (75 mm) unless otherwise specified on the plans.

D. Strip properties and Assembly

1. Perforated Textured Strip/Cell

- a. Strip sheet thickness shall be 50 mils (1.27 mm), minus 5 percent, plus 10 percent in accordance with ASTM D 5199. Determine thickness flat, before surface disruption.
- b. Polyethylene strips shall be textured surface with a multitude of rhomboidal (diamond shape) indentations.
- c. Textured sheet thickness shall be 60 mils, plus or minus 6 mils (1.52 mm plus or minus 0.15 mm).
- d. Indentation surface density shall be 140 to 200 per in² (22 to 31 per cm²).
- e. Perforated with horizontal rows of 0.4 inch (10 mm) diameter holes.
- f. Perforations within each row shall be 0.75 inches (19 mm) on-center.
- g. Horizontal rows shall be staggered and separated 0.50 inches (12 mm) relative to hole centers.
- h. Edge of strip to nearest edge of perforation shall be a minimum of 0.3 inches (8 mm).
- i. Centerline of spot weld to nearest edge of perforation shall be a minimum of 0.7 inches (18 mm).
- j. A slot with a dimension of 3/8 inch x 1-3/8 inch (10 mm x 35 mm) is standard in the center of the non-perforated areas and at the center of each weld.

E. Cell Seam Strength Tests

1. Minimum seam strengths are required by design and shall be reported in test results. Materials submitted with average or typical values will not be accepted. Written certification of minimum strengths must be supplied to the Engineer at the time of submittals.
2. Short-Term Seam Peel-Strength Test
 - a. Cell seam strength shall be uniform over full depth of cell.
4. Minimum seam peel strength shall be 240 lbf (1060 N) for 3 inch (75 mm) depth.
5. Long-Term Seam Peel-Strength Test

6. Conditions: Minimum of 7 days in a temperature-controlled environment that undergoes change on a 1 hour cycle from room temperature to 130 degrees F (54 degrees C).
7. Room temperature shall be in accordance with ASTM E41.
8. Test samples shall consist of two, 4 inch (100 mm) wide strips welded together.
9. Test sample consisting of 2 carbon black stabilized strips shall support a 160 pound (72.5 kg) load for test period.

F. ATRA® Key

1. ATRA keys shall be constructed of polyethylene and provide a high strength connection with minimum pull-through of 275 lbs (125 kg).
2. ATRA keys shall be used to connect Geoweb panels together at each interleaf and end to end connection.

G. CELL INFILL MATERIALS

1. Cell infill material may be crushed No. 57 aggregate depending on cell height and vertical location. Opening size to be based on manufacturer recommendation for the size of the infill material
2. Infill material shall be free of any foreign material.
3. Clays, silts and organics are not acceptable infill material.
4. Infill material shall be free-flowing and not frozen when placed in the Geoweb sections.

1525.03.6 Concrete Pavers: The City has an APPL list for concrete pavers. Only products on that list shall be permitted on City projects.

1525.03.7 Clay Pavers: The City has an APPL list for clay pavers. Only products on that list shall be permitted on City projects.

1525.03.8 Geomembrane PVC Liners: PVC Geomembrane liners may be used to prevent migration of runoff into native soils to protect existing structures, utilities, or other items of concern. It can also be used to optimize water storage in the stone subgrade in sloped subgrade applications.

A. Meets the requirements of ASTM D-7176, which is the standard specification for Non-reinforced Polyvinyl Chloride (PVC) Geomembranes Used in Buried Applications

B. Minimum thickness 30 mil

1525.04 EXECUTION – CONSTRUCTION REQUIREMENTS

1525.04.1 Inspection:

- A. Prior to commencement of any work, the Contractor shall conduct a pre-installation meeting. This pre-installation meeting should, at a minimum, include:
 - 1. Field walk of the proposed improvements with the Engineer.
 - 2. Review of underground utility markings, trees, and any tree trimming necessary to complete the project.
 - 3. The details of the site's Erosion and Sediment Control Plan.
 - 4. Traffic control plan including pedestrian pathways and measures needed to address any residents with special needs impacted by the construction. Detail planned access to property, phasing, and duration.
 - 5. Review of the City's quality control plan.
- B. Although the Engineer may provide soil testing and quality assurance inspection during earthwork, aggregate placement, and Subgrade preparation, the Engineer's quality assurance program does not relieve the Contractor of responsibility for quality control and system performance.
- C. Where deficiencies or inconsistencies are identified, the Contractor shall notify the Engineer in writing. The Contractor will not proceed with the work until the Engineer has verified that the deficiencies or inconsistencies have been addressed.

1525.04.2 Subgrade Preparation

- A. Construct or fine grade the subgrade to within 1/2 inch of the plan grade as measured with a 10-foot straightedge applied to the surface parallel to the centerline of pavement.
- B. For cohesive soils, proof roll per CMSC 204.06. Where proof rolling is not achievable due to inaccessible locations, acceptance of subgrade associated with cohesive soils shall pass the 1-point compaction test per SS 1501.

1525.04.3 Subgrade Stabilization Geotextile & Geomembrane PVC Liner:

- A. Place the Geotextile directly on prepared surface and on the sides as shown on the typical section. The Geotextile should be deployed flat and tight with no wrinkles or folds. The rolls should be oriented in the direction of traffic to ensure the principle strength direction of the material is placed in the correct orientation. Adjacent rolls should be overlapped by 18-inches. Prior to fill

placement, the geotextile should be held in place using suitable means such as pins, soil, staples and sandbags to limit movement during fill placement.

- B. The surface of the subgrade should be relatively smooth and level, and depressions or humps greater than 6-inch should be graded out.
- C. Sudden braking, sudden starting and sharp turning should be avoided. Tracked construction equipment must not be operated directly upon the exposed Geotextile. A minimum aggregate fill thickness of 6 inches is required prior to operation of tracked equipment on the Geotextile.
- D. In some cases, an impermeable PVC membrane liner is required as shown on the road profiles. Install liner per manufacturer recommendations. A liner installed on the bottom and sides of the trench shall be installed between the subgrade stabilization geotextile and native subgrade material to help protect it from being damaged during aggregate placement. PVC liners not installed along the bottom or sides of the trench shall be protected by covering any side exposed to aggregate with a subgrade stabilization geotextile.

1525.04.4 Installation of Aggregate Sub-base and Base

A. General

1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the geotextile and subbase materials.
2. Keep area where pavement is to be constructed free from sediment during entire job. Base and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
3. Do not damage drain pipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

B. At the specified elevation(s), install the underdrain pipes and storm sewer and associated backfill in accordance with the construction drawings. Care must be taken not to damage the drain tiles and storm sewer during subsequent aggregate installation.

C. Open-graded subbase and base

1. Moisten, spread and compact the No. 2, or 4 subbase in maximum 12 inch lifts [without wrinkling or folding the geotextile. Place subbase to protect geotextile from wrinkling under equipment tires and tracks.] Do not place subbase aggregate on a subgrade or geotextile with water ponded on it unless directed by the Engineer
2. For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (8 T) vibratory roller until there is no visible movement of the No. 2 or 4 stone. Do not crush aggregate with the roller.
3. Use a minimum 13,500 lbf (60 kN) plate compactor with a compaction indicator to compact areas that cannot be reached by the vibratory roller. Do not crush the aggregate with the plate compactor. When using this plate compactor, maximum lift height is 12-inch.
4. The final surface tolerance of the compacted subbase shall be ± 2 inches (± 25 mm) over a 10 foot (3 m) straight edge.
5. Where cellular confinement is specified, install as per 1525.04.5 with the top of the cellular confinement being 1-inch below the finish grade of the No. 57 stone layer. Moisten spread and over fill the cellular confinement material with No. 57 aggregate then compact with roller

and test for deflection. DO NOT roll the No. 57 aggregate in vibratory mode as it may damage the cellular confinement system, only roll in static mode.

6. Moisten, spread and compact the No. 57 base layer in one lift no less than four and no more than 12 inches. Make at least two passes in the vibratory mode, only if not using a cellular confinement system in the No. 57 layer, then at least two in the static mode with a minimum 10-ton vibratory roller until there is no visible movement of the No. 57 stone. Do not crush aggregate with the roller.
7. The surface tolerance of the compacted No. 57 base should not deviate more than. $\pm 1/2$ inch over a 10 foot straight edge.
8. Use a Light Weight Deflectometer (LWD) to measure deflection on all lifts of stone aggregates except the aggregate setting bed layer.
 - a. The LWD test method should comply with ASTM E-2835.
 - b. Conduct tests on a +/- 20-foot grid throughout the area being constructed
 - c. After three preloading drops, the maximum average deflection from three additional drops should be no greater than 1.0 mm for the No. 2, or 4 subbase layer. Areas with greater than 1.0 mm deflection should be rolled again and re-rested. If after subsequent rolling the deflection is still over 1.0 mm but has not changed by more than 5% from the previous test, the material may be approved by the Engineer at their discretion.
 - d. Deflection values of less than 0.50 mm are required for the No. 57 aggregate base layer.
 - e. For all tests, record the average deflection, location of the test, the approximate total depth of aggregate below the plate and the type of aggregate tested.

Note: Testing performed on the first lift of the No. 2 and 4 aggregate layer may show higher deflection results than 1.0 mm due to the interaction of the natural subgrade. This is acceptable and the contractor may proceed to the next lift of stone if the testing values remain above 1.0 mm after subsequent passes with the roller or plate compactor.

Note: This test method describes the use of a lightweight deflectometer (LWD) that can be used for in-situ deflection testing of open graded aggregates. This test method can assist contractors in reaching adequate job site compaction and offer an additional level of confidence for the project Engineer. This test method is appropriate for pavement subject to consistent vehicular traffic such as parking lots and roads. This test protocol is not

needed for pedestrian areas and residential driveways. The LWD test method should comply with ASTM E2835.

Note: The LWD can only test aggregate to a depth that is equal to the diameter of the load plate. It cannot verify the quality of the consolidation of material that exceeds the diameter of the plate. A 10-12 ton roller can generally do a good job of compacting and consolidating material up to 18-inch in thickness, however, it is recommended that lift thickness not exceed the diameter of the LWD load plate to confirm consolidation of material.

8. Aggregate Setting Bed

- a. Moisten, spread, and screed the No. 8 stone bedding material using an approved mechanical spreader, screed rails, or board the No. 8 stone bedding material to a nominal 1 1/2 in. thickness.
- b. Fill and level voids left by removed screed rails with No. 8 stone.
- c. The surface tolerance of the screeded No. 8 bedding layer shall be $\pm 3/8$ in. over a 10 foot straightedge.
- d. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.

1525.04.5 Installation of Cellular Confinement System

- A. Prepare subgrade and install the cellular confinement load support system in accordance with Manufacturer's instructions.
- B. Subgrade Preparation
 1. Excavate and shape foundation aggregate as indicated on the drawings.
 2. Ensure foundation aggregate is approved by the Engineer.
- C. Cellular Confinement Section Placement and Connection
 1. Place cellular confinement sections and verify all sections are expanded uniformly to required dimensions and that outer cells of each section are correctly aligned. Interleaf or overlap edges of adjacent sections. Ensure upper surfaces of adjoining cellular confinement sections are flush at joint and adjoining cells are fully aligned at the cell wall slot.
 2. Connect the cellular confinement sections with ATRA keys at each interleaf and end to end connection. Insert the ATRA key through the cell wall slot before inserting through the adjacent cell. Turn the ATRA key 90 degrees to lock the panels together. Cellular confinement sections may also be connected with pneumatic staplers either side-to-side or end-to-end.
- D. Aggregate Base No. 57 Placement

1. Place the No. 57 aggregate infill with suitable material handling equipment.
2. The aggregate shall be free-flowing and not frozen when placed in the cellular confinement sections.
3. Overfill cells with aggregate infill material. Limit the drop height of infill material to 3 feet (1 meter) to avoid damage or displacement of the cell wall.
4. Level surface approximately 1 1/2 inches above cell walls. Maintain the 1-inch wear surface over the cell sections to prevent damage to the cell walls.
5. Compact infill material per 1525.04.4 and shape surface to required elevation and grade shown on plan but do not roll in vibratory mode, only use static mode.

1525.04.6 Installation of Edge Restraints

- A. Edge restraints made of concrete or other acceptable rigid materials shall be provided along the perimeter of all permeable pavers as shown on the construction plans. Typical edge restraints include Std. Dwg. 2000 and 2005, as well as Std. Dwg. XXXX for transitioning from permeable paver roadway to concrete or asphalt roadways.
- B. All concrete edge restraints shall be constructed to dimensions and level specified and shall be supported on a compacted aggregate base not less than 6 inch thick.
- C. Concrete used for the construction of edge restraints shall be as specified on the standard details.
- D. All roadway castings where pavers abut, shall have a minimum 8-inch concrete collar boxed out (square or rectangular) around the casting to include, but not limited to storm inlets, manholes, water valves, etc., per Std. Dwg. XXXX.

1525.04.7 Installation of Pavers

- A. Install pavers in accordance with the plan specified shape, color, pattern, and treatments along edge restraints, manholes, catch basins, and other obstructions.
- B. Ensure that pavers are free of foreign material before installation. Pavers shall be inspected for color distribution and all chipped, damaged or discolored pavers shall be replaced. Initiation of paver placement shall be deemed to represent acceptance of the pavers.

- C. Lay the pavers in a 90(degree) herringbone pattern if not installing an “L” shaped paver according to manufacturer's recommendations with soldier or sailor course along edge restraints. Maintain straight pattern lines. For mechanical installations, follow the stitching details submittal (reference Article 1.05) as accepted during the Mock Up.
- D. Paving units shall be installed from a minimum of three bundles for hand installations, 6 bundles for mechanical installations, simultaneously to ensure color blending.
- E. Joints between the individual pavers shall be maintained according to the spacer bars.
- F. Fill gaps at the edges of the paved area with cut pavers or edge units. Do not install cut pavers smaller than one-third of a whole paver along edges subject to vehicular traffic - trim two pavers to fit.
- G. Cut pavers using masonry saw with dust collection equipment. Upon completion of cutting, the area must be swept clean of all debris to facilitate inspection and to ensure the pavers are not damaged during compaction.
- H. Using a low amplitude plate compactor capable of at least 5,000 lbs. (22 kN) compaction at a frequency of 75 hz -90 hz, compact and seat the pavers into the bedding course. For face-mix concrete pavers such as the EnduraColor finish by Unilock, a urethane cover is recommended over the steel plate to reduce the damage to the surface of the pavers during this process.
- I. The pavers shall be compacted to achieve consolidation of the bedding course and brought to level and profile by not less than three passes. Initial compaction should proceed as closely as possible following the installation of the paving units and prior to the acceptance of any traffic or application of permeable joint material.
- J. All pavers shall be sound and free of defects that would interfere with the proper placing of the units or impair the strength or performance of the construction. Minor cracks incidental to the usual methods of manufacturing or minor chipping resulting from customary methods of handling in shipment and delivery shall not be deemed grounds for rejection. Any units that are structurally damaged during compaction shall be immediately removed and replaced consistent with the requirements of ASTM C1272. The paver shall be free of cracks or other imperfections when viewed from a distance of 15-feet. Corners that are chipped off shall have the paver removed and replaced when the size of the chippage is approximately the size of a dime, which is roughly the smallest chippage that is noticeable from 15-feet away. The cumulative length of chips on the exposed face of a single unit shall not

exceed 10% of the perimeter of the exposed face of the paver. Pavers that have the top surface crumble during compaction shall also be replaced.

- K. Apply the paver manufacturer recommended joint aggregate material to the surface and sweep into the joints and voids. Fill joints and voids, and then sweep off excess material before vibrating the material down into the joints using a plate compactor. This will require at least two or three passes with the compactor.
- L. Do not compact within 6 feet of the unrestrained edges of the paving units.
- M. All work to within 6 feet of the laying face must be left fully compacted at the end of each day. Cover the laying face with plastic sheets overnight if not closed with cut and compacted pavers.
- N. Sweep off excess aggregate when the job is complete. After being swept clean, the completed surface shall be swept clean and washed down with water to provide a finished workmanlike installation.
- O. The final surface tolerance of compacted pavers shall not deviate more than $\pm 3/8$ under a 10 feet (3 m) long straightedge.
- P. The surface elevation of the pavers shall be 1/8 to 1/4 inch (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
- Q. Bond lines for paver courses: $\pm 1/2$ inch (± 15 mm) over a 50 feet (15 m) string line.
- R. Verify the surface infiltration at a minimum of 100 in/hour using ASTM test method C 1781.

Note: The surface of the pavers may be 1/8-inch to 1/4-inch above the final elevations after compaction. This helps compensate for possible minor settling normal to pavements.

1525.04.08 Maintenance and Protection

- A. After completion of the work, the Contractor and Engineer shall inspect the paver area(s) and determine if a partial restoration is required due to contamination of the voids during construction. Paver contractor will be responsible for executing this work should it be deemed necessary at their own cost.
- B. All completed pervious pavement areas shall be protected from damage and contamination throughout the life of the project. All costs associated with

protecting completed areas shall be included in the Permeable Pavement Roadway Pay Item.

1525.05 QUALITY CONTROL AND ASSURANCE

- A. Compaction testing for the aggregate test sections to be performed by the Engineer.
- B. Quality control should include at a minimum daily verification with the Engineer that the Contractor's quality control plan is adequate and meets the City of Columbus CMS specifications. Quality control shall also include observation of construction for general compliance with design drawings and project specifications.
- C. Final paver inspection shall be conducted to verify conformance to the drawings after removal of excess aggregate. All pavements shall be finished to lines and levels to ensure positive drainage at all drainage outlets and channels.
- D. The final paver surface elevations shall not deviate more than +/- 3/8 inch under a 10-foot long straight edge.
- E. Paver lippage shall be no greater than 1/8 inch difference in height between adjacent pavers
- F. Bond lines for the pavers shall be +/- 1/2 inch over a 50-foot string line.
- G. The top surface of the pavers may be 1/8 to 1/4 inch above adjacent inlets, concrete collars, or other features, this difference is to compensate for possible minor settling.

1525.06 METHOD OF MEASUREMENT

- A. The permeable pavers will be measured by the number of Square Yards completed and accepted in place. Square yardage will be measured at the surface of the pavement. This shall include all labor, equipment, materials, and incidentals necessary for the described work including, but not limited to, pavers, joint aggregate, aggregate setting bed, and concrete collars around roadway castings.
- B. The Subbase and Base aggregate will be measured by the number of cubic yards completed and accepted in place. The width equals the pavement width shown on the typical cross-section and the height based on the profile plus any additional widening as directed by the Engineer. The City will field measure the length along the centerline of each installation. The City will determine the volume based on the above width, height and length. The City will measure the elevation at which the materials change from subbase to base aggregate and note any changes based on the typical section.
- C. The subgrade stabilization geotextile will be measured by the width of the pavement shown on the typical cross-section and the height based on the profile plus any additional widening as directed by the Engineer. No additional compensation is given for the required overlapping of the material. No additional compensation is given for waste product.
- D. The cellular confinement system will be measured by the square yard of product completed and accepted in place.
- E. The geomembrane PVC liner will be measured by the number of square yards shown on the plans plus any additional area as directed by the Engineer. No additional compensation is given for the required overlapping of the material and geotextiles installed to protect the fabric when not installed along the bottom or sides of the installation trench.
- F. Concrete edge restraints, other than standard concrete curbs meeting CMSC 609, will be measured by the linear feet completed and accepted in place.

1525.07 BASIS OF PAYMENT

The City will pay for all work as described in 1525.

The City will pay for accepted quantities at contract price as follows:

Item	Unit	Description
1525	Square Yard	Subgrade Stabilization Geotextile
1525	Cubic Yard	Aggregate Sub-base No. 2 or 4 stone
1525	Cubic Yard	Aggregate Base, No. 57 Stone
1525	Square Yard	Cellular Confinement System (T=__")
1525	Square Yard	Permeable Paver Roadway
1525	Square Yard	Geomembrane PVC Liner (__ mil)
1525	Linear Feet	Permeable Pavement Concrete Edge Restraint Type (__)

1525.08 WARRANTY

- A. Contractor shall warrant the finished paver pavement for a period of two years from the date of City acceptance of the pavement system.
- B. Joint Material Loss: The pavement shall be inspected at the 1st year anniversary and 18 months after acceptance by the City; if required, Contractor shall reinstall joint material in areas of joint material loss as directed by the City.
- C. Creep: The pavement shall be inspected for paver creep at the 1st year anniversary after acceptance by the City; if required, Contractor shall replace pavers that are affected and re-apply jointing material as directed by the City. The maximum allowable horizontal creep is 0.4".
- D. Rutting, Settling or Cracking: The pavement shall be inspected for rutting, settling or cracking at the 1st year anniversary after acceptance by the City; if required, Contractor shall replace full depth of paver installation to initial elevations in affected areas as directed by the City. The maximum allowable vertical rutting is 0.5".